



Current Orbiter Capabilities for Future Landing Site Selection

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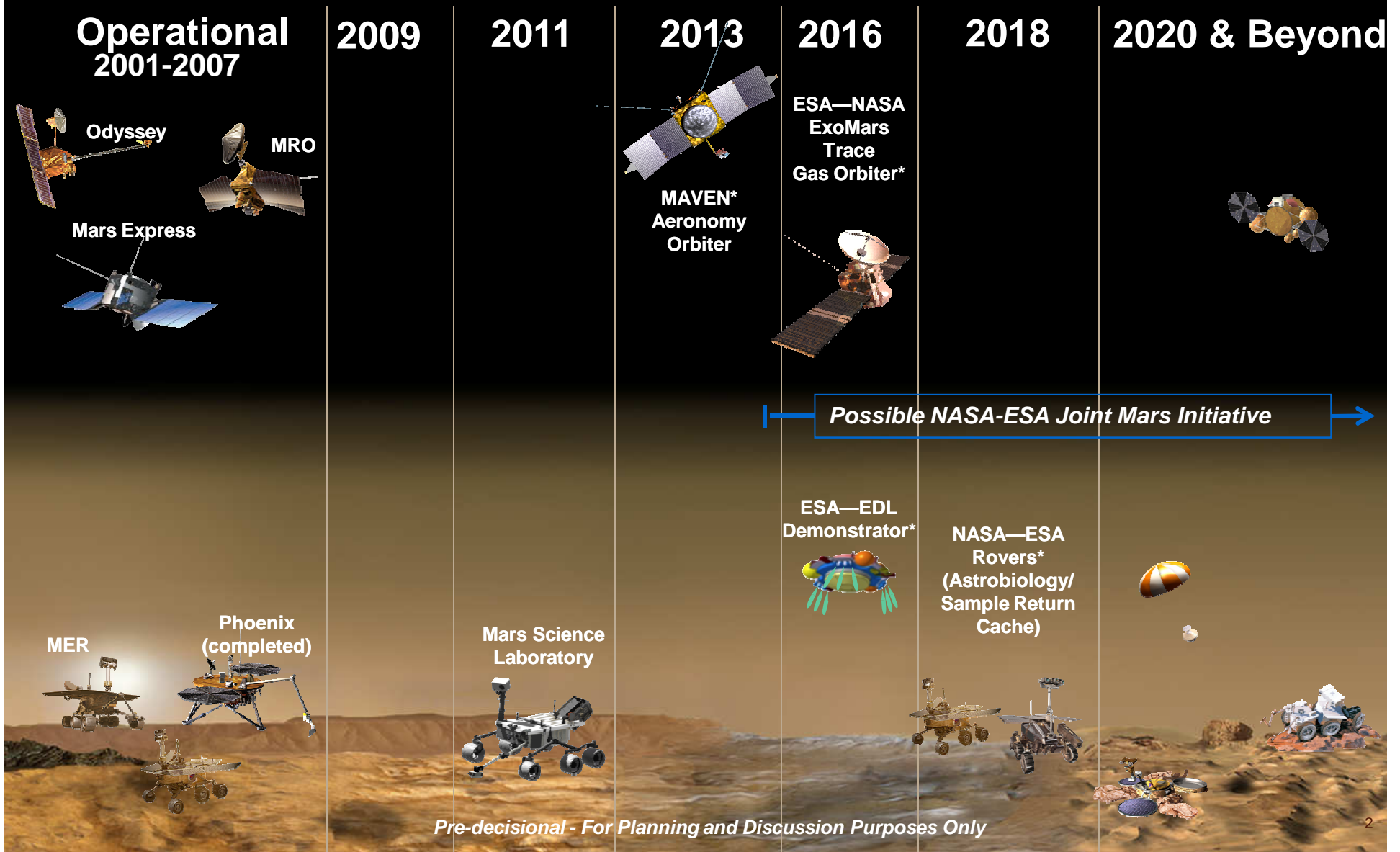




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Proposed* Mars Mission Architecture

**Proposed Missions*





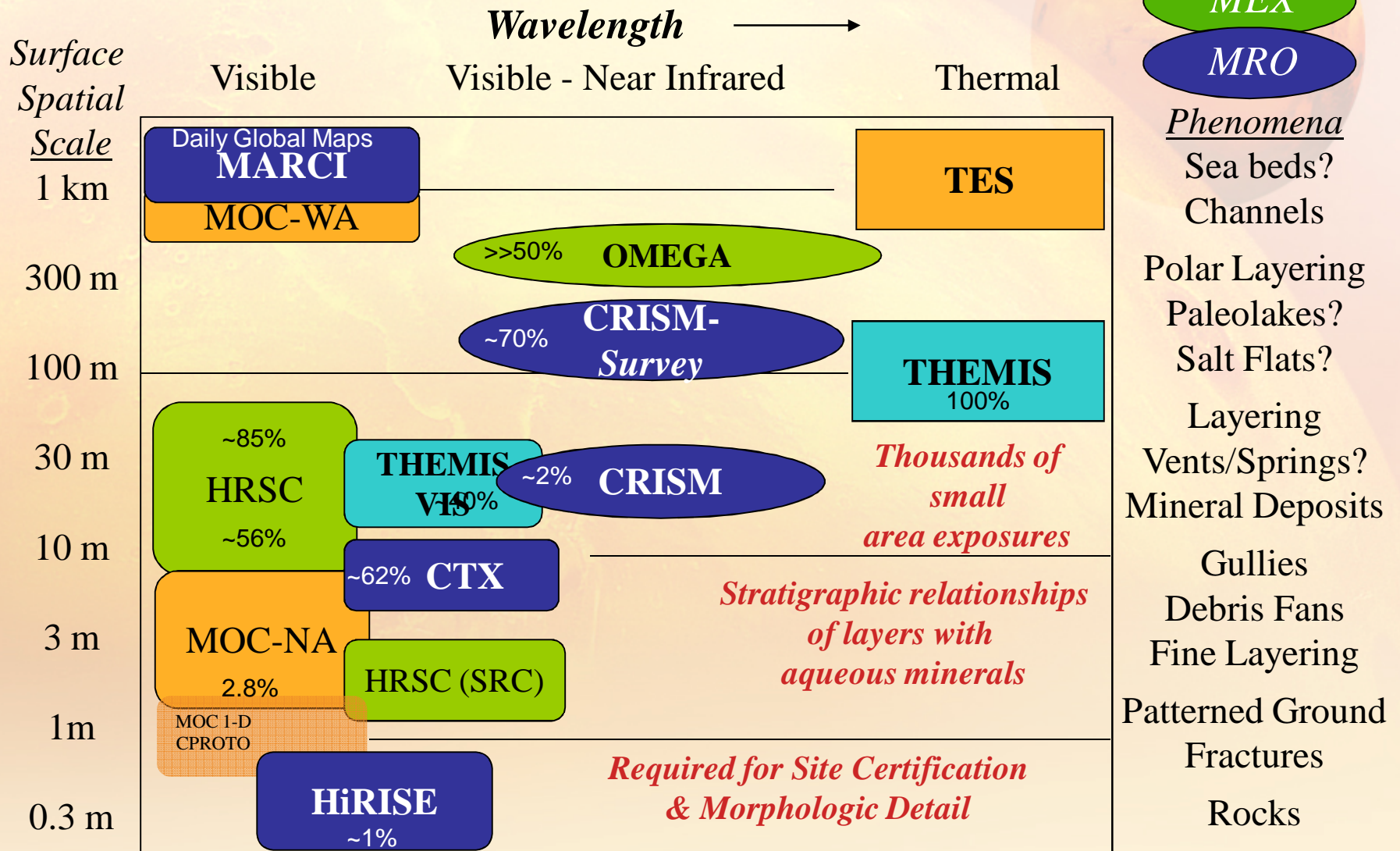
Orbiter Support for Future Missions

- **Orbital Information is critical to future missions landing on Mars in the following ways:**
 - *Identification, Characterization, and Certification (for safety) of landing sites*
 - *Characterization of atmospheric environments for EDL*
 - *Characterization of surface environments for landed operations*
- **MER, PHX and MSL have all benefited from such data**
- **Future landers now proposed include the ExoMars 2016 EDM and a 2018 Dual Rover missions**
- **Large areas of the planet have been covered at increased spatial resolutions, with some coverage continuing to expand**
- **Major assets for providing additional critical data are currently: ODY, MEX, MRO**
 - *2016 EMTGO data would arrive late in the process for any launch in 2018*



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Observation Attributes





Surface Coverage

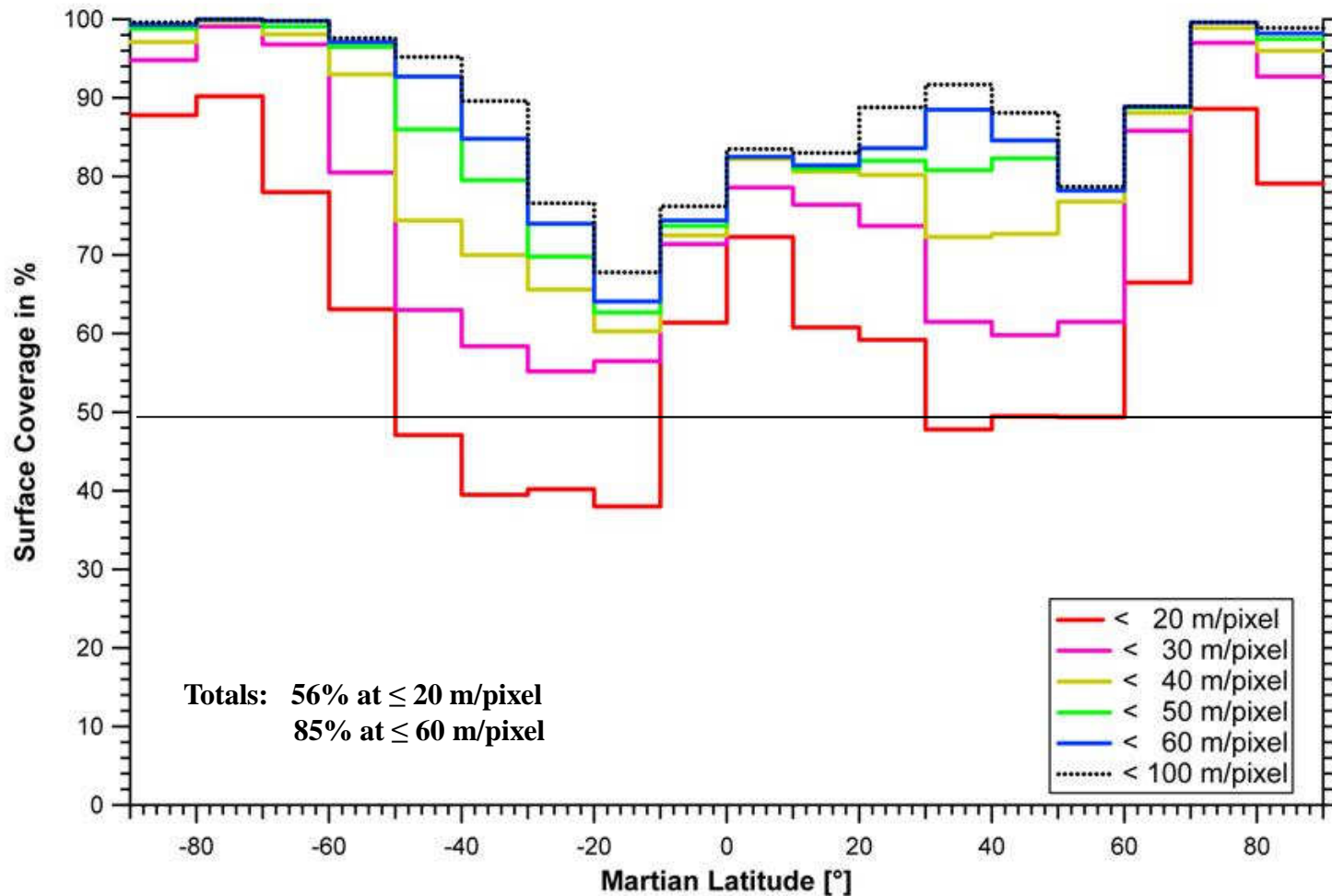
Project	Team	Observation	Objective	Resoln: m/pixel	Coverage*
ODY	THEMIS	(mid) Day IR	Composition	100	~ 40% (55%)
		(late) Day IR	Morphology	100	~100%
		Night IR	Thermal Inertia	100	~100%
		VIS	Morphology	18	~ 40% (54%)
MEX	HRSC	VIS (color, stereo)	Morphology	≤ 20 ≤ 60	~56% ~85%
	OMEGA	VIS-IR	Composition	~300	>> 50%
	CRISM	VIS-NIR	Composition	~200 in 72 bnd ~200 in 264 bnd ~ 18 in 544 bnd	~70% (80%) ~15% ~ few %
MRO	CTX	VIS (stereo)	Morphology	~ 6	62%
	HiRISE	VIS (stereo, color swath)	Morphology (composition)	~0.3 – 0.6 (color)	~ 1%

* % of Mars surface covered with good quality data (total including high opacity periods)



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MEX HRSC Coverage



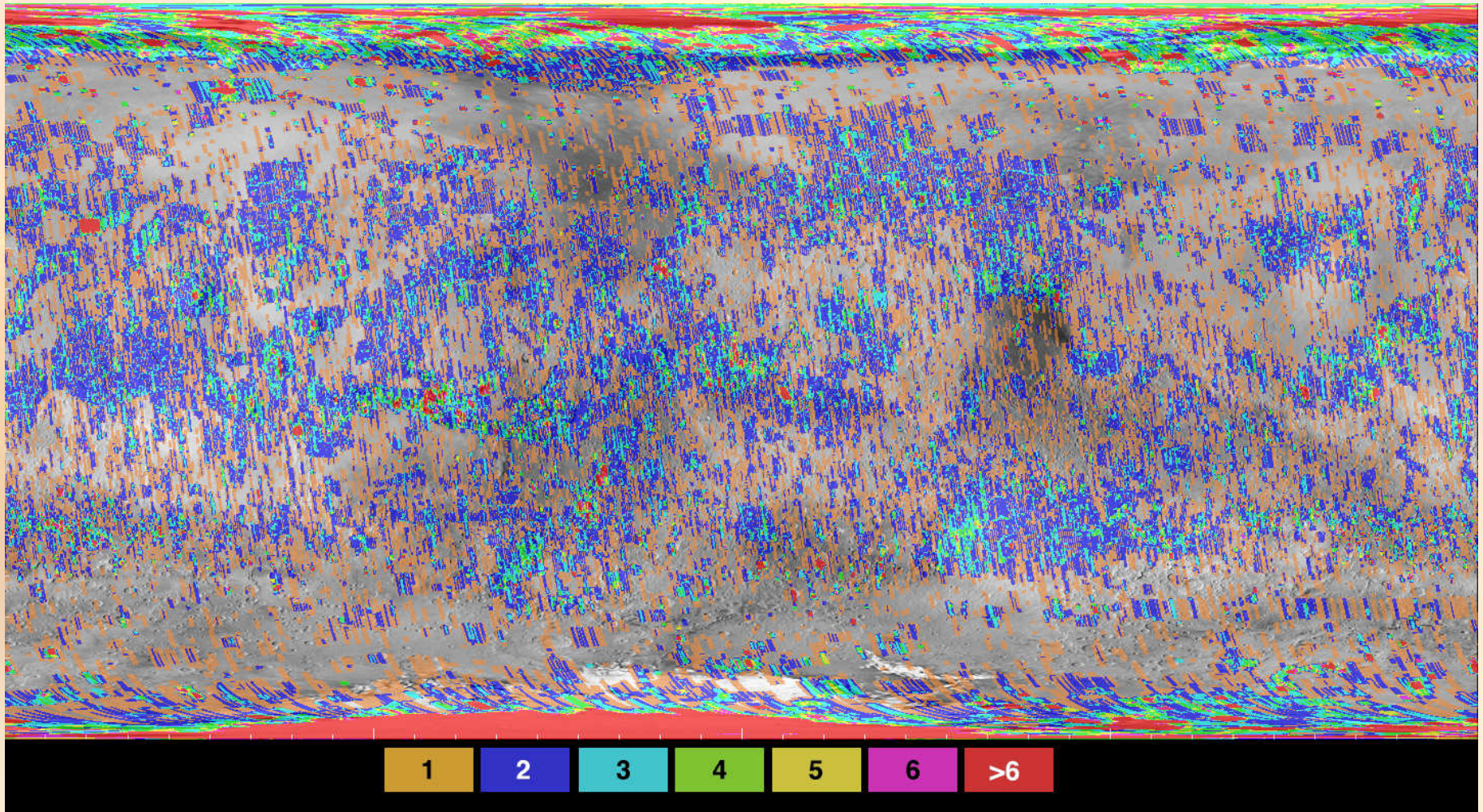


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MRO CTX Coverage Map

As of July 31, 2010

MSSS / JPL / NASA



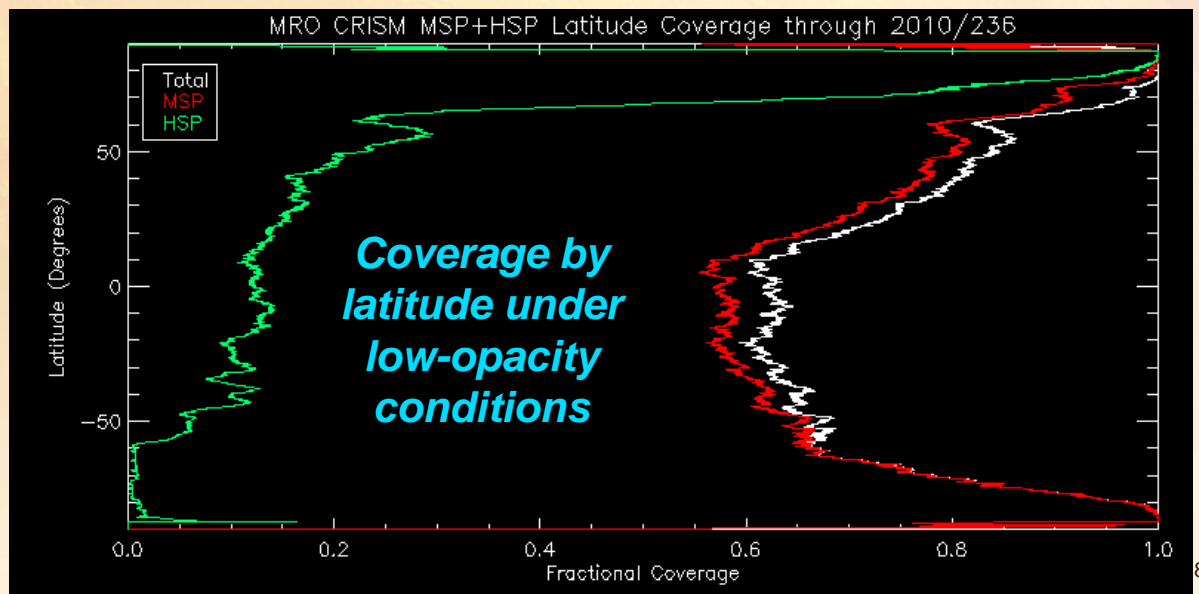
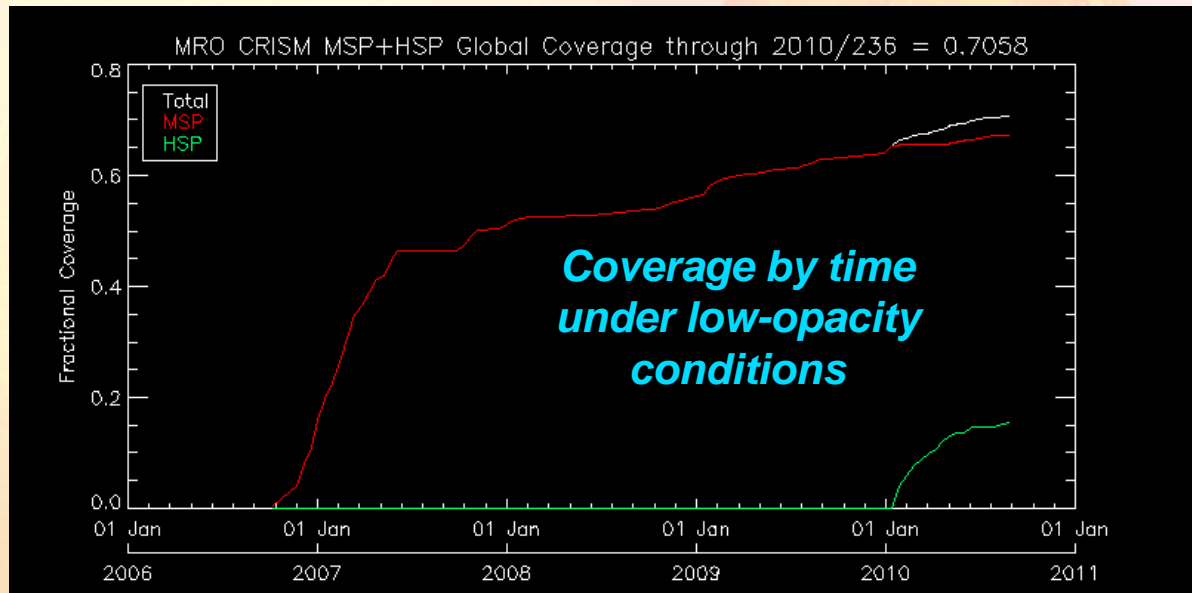


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MRO CRISM Coverage (as of Sep. 2010)

Type	PSP+ESP	ESP
FRT	10045	3918
HRL	3195	1286
HRS	1719	795
Targeted total	14959	5999
EPF	5885	2164
LMB	94	94
Gimbaled Total	20938	8257
TOD	9452	6082
MSW	2557	0
MSP segment	43038	12547
HSP segment	6968	6968
HSV segment	1449	1449
Survey segment total	51455	20964

~71% low-opacity
mapping coverage





Capabilities for Site Selection (1 of 2)

- **ODY: Approved for second Extended Mission (FY11-12)**
 - *THEMIS IR & VIS: Working well in mid-afternoon orbit*
 - *Limited fuel will still support operations thru MSL prime mission*
- **MEX: Approved thru FY10, likely to be confirmed thru 2012, and request to be extended thru FY14 under review**
 - *Uncertain remaining fuel load should support operations thru this period*
 - *Orbit phasing periodically limits day-time viewing*
 - *All instruments still operating*
- **MRO: Approved for first full Extended Mission (FY11-12)**
 - *Telecom is essentially single string, but has been that way for 4 years*
 - *Safe mode entries vexing, but not thought to be life-limiting*
 - *Fuel not currently an issue given latest scenarios for covering MSL EDL*
 - *MCS, MARCI, CTX, SHARAD continue to work as in PSP/ESP*
 - *HiRISE and CRISM have seen some degradation (next slide)*



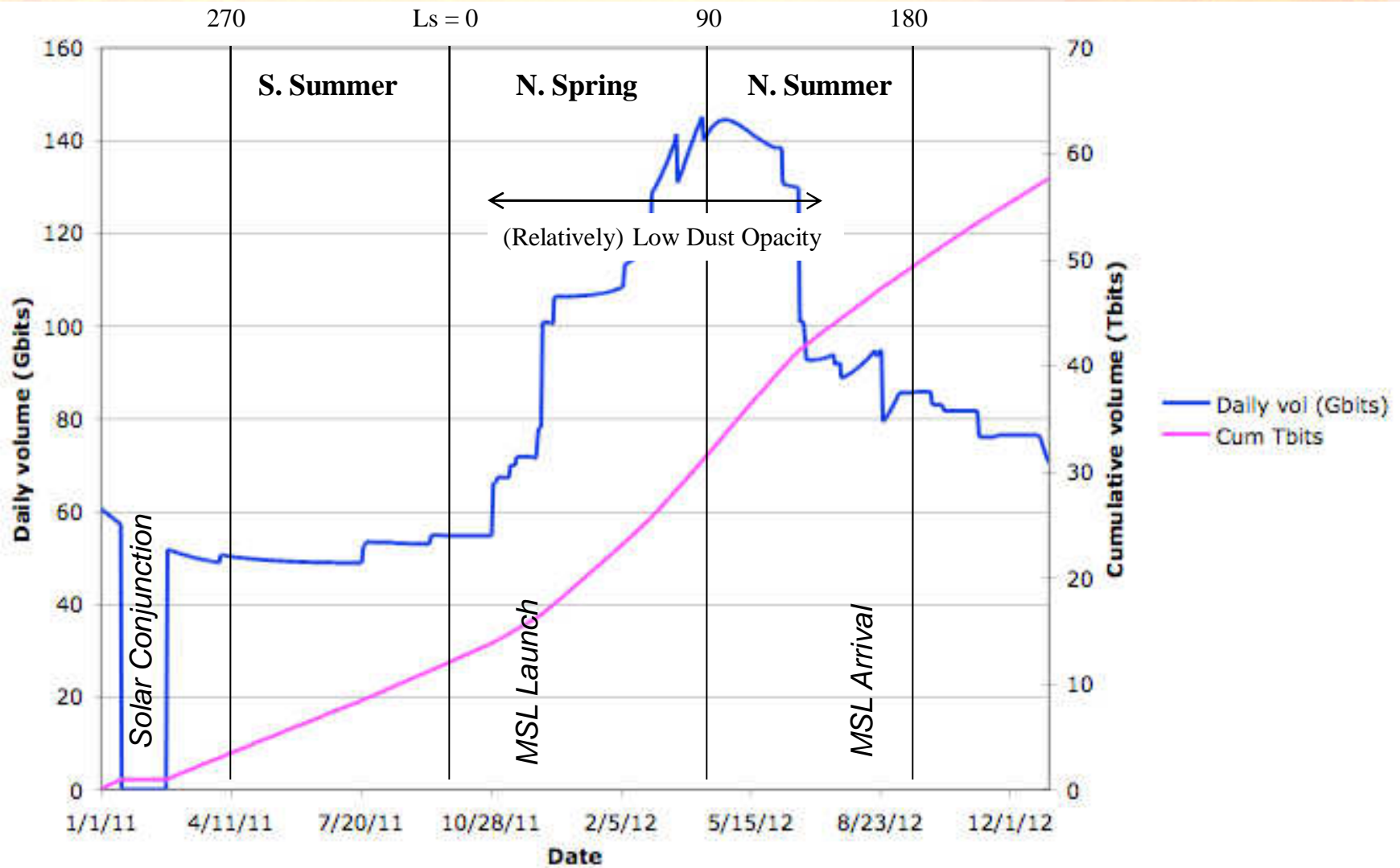
Capabilities for Site Selection (2 of 2)

- **MRO instrument issues:**
 - *HiRISE: Team has used longer and more frequent warm-ups to compensate for increasing ADC (analog to digital converters) bit flip errors*
 - Considering an onboard annealing sequence which ground testing indicates could reduce errors by breaking up and dispersing the ADC contamination
 - *CRISM: Both the gimbal (needed for high resolution) and the coolers (needed for IR observations) have degraded with time*
 - Plan: Use full VNIR/IR capability for 2 weeks every other month in mini-campaigns focused on high priority items (especially during periods of higher data rate)
 - VNIR-only mode can be used at other times (but avoid major dust events)
 - VNIR (0.4 to 1.1 μ m) aqueous mineral signatures are limited to ferric minerals
 - ***Bottom Line: Full-resolution VNIR/IR targeting reserved for high priority targets***



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MRO EM Predicted Data Volumes





Summary

- **Current Orbiter capabilities for support of future landed missions are substantial, but instruments and spacecraft are aging**
 - *Best to start the process now for **proposed** missions like 2018*
 - *Need site criteria (e.g., as being developed by the E2E SAG)*
 - *Need to use the capabilities conservatively where instrument and/or spacecraft limitations dictate*
- **Landing site selection processes should be structured so that the life-limited capabilities are used only for the highest priority items**
 - *Need to use the data already in hand—there's a lot, even though more needs to be done on many interesting places*
 - *Need to set site priorities using existing data and increased coverage of lower resolution/survey observations*
 - *May be useful to exploit correlations that have emerged between spectral and visible imagers (e.g., color variations and VNIR, IR & thermal IR)*
 - *Need to have realistic expectations about the number of sites that **could** be certified (i.e., with nearly complete high resolution coverage) and the schedule of data acquisition*